
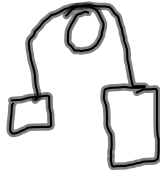
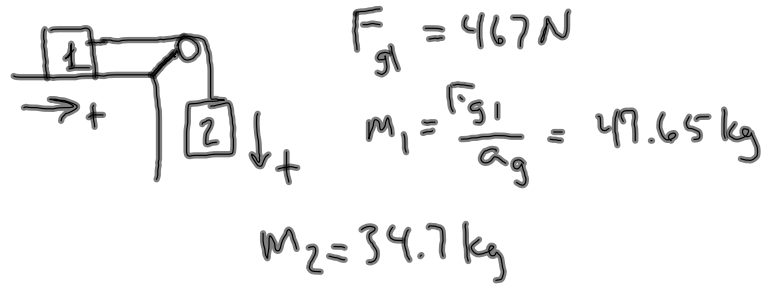


Test Topics:

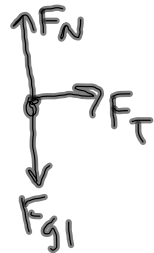
- Net Forces (force triangles)
- 1-D forces (x- or y-direction)
- Tug-of-War
- Friction
 - Pulling horizontally
 - Pulling at an angle
- Pulley I 
- Pulley II 
- Conceptual questions about types of forces and Newton's laws
- You will have to know Newton's laws!

Pulley Practice Problems 3.13.12 CP Physics

A 467 N block on a table is attached, via a rope and pulley, to another block of mass 34.7 kg that hangs off the table. If we ignore friction, what would the acceleration of the blocks be?



FBD 1:



FBD 2:



$$\Sigma F_1 = m_1 a$$

$$\Sigma F_2 = m_2 a$$

$$F_T = m_1 a$$

$$F_{g2} - F_T = m_2 a$$

$$F_{g2} - m_1 a = m_2 a$$

$$m_1 a + m_2 a = F_{g2} = m_2 a_g$$

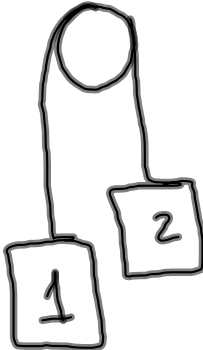
$$a(m_1 + m_2) = m_2 a_g$$

$$a = \frac{m_2 a_g}{m_1 + m_2}$$

$$= \frac{(34.7 \text{ kg})(9.8 \text{ m/s}^2)}{47.65 \text{ kg} + 34.7 \text{ kg}}$$

$$= 4.13 \text{ m/s}^2$$

Pulley II Problems:

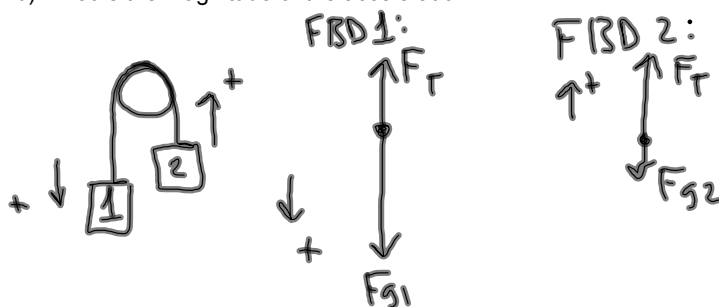
| | <u>Mass</u> | <u>1 goes...</u> | <u>2 goes...</u> |
|---|-------------|------------------|------------------|
|  | $m_1 = m_2$ | nowhere | nowhere |
| | $m_1 > m_2$ | down | up |
| | $m_1 < m_2$ | up | down |

- Variables that both have the same:
 - F_T (tension on rope)
 - acceleration
- Make the positive direction the direction of acceleration.
- There will be a different positive direction for the masses.

Pulley Practice Problems 3.13.12 CP Physics

Two hanging blocks (block 1 mass = 8.0 kg; block 2 mass = 5.0 kg) are attached by a rope that is hung over a frictionless pulley.

- a) Which way does each block accelerate?
b) What is the magnitude of the acceleration?



$$\sum F_1 = m_1 a \quad \sum F_2 = m_2 a$$

$$F_{g1} - F_T = m_1 a \quad F_T - F_{g2} = m_2 a$$

$$F_T = F_{g2} + m_2 a$$

$$F_{g1} - (F_{g2} + m_2 a) = m_1 a$$

$$F_{g1} - F_{g2} - m_2 a = m_1 a$$

$$F_{g1} - F_{g2} = m_1 a + m_2 a$$

$$F_{g1} - F_{g2} = a(m_1 + m_2)$$

$$a = \frac{F_{g1} - F_{g2}}{m_1 + m_2} \quad F_g = m a_g$$

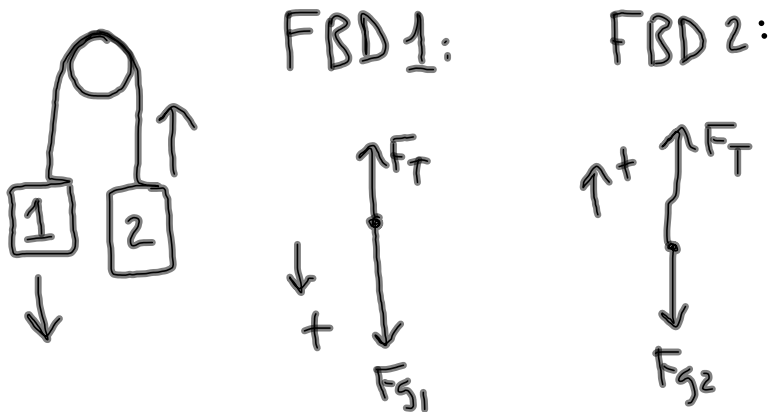
$$= \frac{m_1 a_g - m_2 a_g}{m_1 + m_2}$$

$$= \frac{(8 \text{ kg})(9.8 \text{ m/s}^2) - (5 \text{ kg})(9.8 \text{ m/s}^2)}{8 \text{ kg} + 5 \text{ kg}}$$

$$= 2.26 \text{ m/s}^2$$

Pulley Practice Problems 3.13.12 CP Physics

Two masses are hanging by a rope passed over a pulley. The mass on the left is 7.89 kg, and the mass on the right is 6.87 kg. What is the acceleration of the block on the right?



$$\sum F_1 = m_1 a \quad \sum F_2 = m_2 a$$

$$F_{g1} - F_T = m_1 a \quad F_T - F_{g2} = m_2 a$$

$$F_T = F_{g2} + m_2 a$$

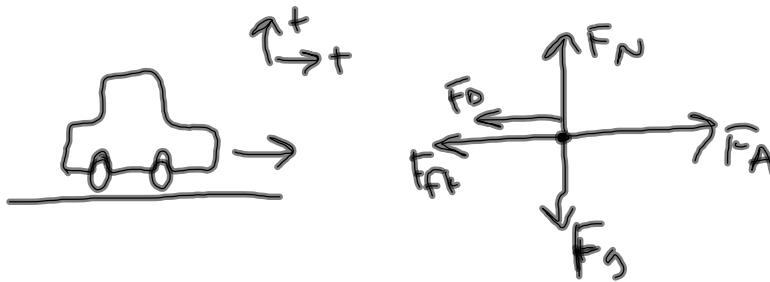
$$F_{g1} - F_{g2} - m_2 a = m_1 a$$

$$a = \frac{m_1 a_g - m_2 a_g}{m_1 + m_2}$$

$$= 0.677 \text{ m/s}^2$$

Pulley Practice Problems 3.13.12 CP Physics

A car of mass 1155 kg is moving at a constant velocity to the right, with a force of drag equal to 45 N and a coefficient of friction of 0.233. What is the applied force necessary to keep the car moving at a constant velocity?



$$a_x = 0 \text{ m/s}^2$$

$$\sum F_x = 0$$

$$F_A - F_{fk} - F_D = 0$$

$$\begin{aligned} F_A &= F_{fk} + F_D \\ &= 2637 \text{ N} + 45 \text{ N} \\ &= 2682 \text{ N} \end{aligned}$$

$$\begin{aligned} F_{fk} &= \mu_k F_N \\ &= (.233)(11319 \text{ N}) \\ &= 2637 \text{ N} \end{aligned}$$

$$\begin{aligned} \sum F_y &= 0 \\ F_N - F_g &= 0 \end{aligned}$$

$$\begin{aligned} F_N &= F_g \\ &= (1155 \text{ kg})(9.8 \text{ m/s}^2) \\ &= 11319 \text{ N} \end{aligned}$$